EL977166006US



Docket No. AUS920030875US1

# METHOD, SYSTEM, AND PRODUCT FOR INDICATING POWER STATUS OF FIELD REPLACEABLE UNITS

## CROSS-REFERENCE TO RELATED APPLICATIONS

This subject matter of the present application is related to commonly assigned and co-pending U.S. Patent Application Serial Number _____, (Attorney Docket Number AUS920030876US1), entitled METHOD, SYSTEM, AND PRODUCT FOR HIERARCHICAL ENCODING OF FIELD REPLACEABLE UNIT SERVICE INDICATORS, filed on the same date herewith, assigned to the same assignee hereof, and hereby incorporated by reference.

## BACKGROUND OF THE INVENTION

### 1. Technical Field:

The present invention relates generally to an improved data processing system, and in particular to a method, system, and product for indicating power status for field replaceable units (FRUs) where hierarchically encoded service indicators are used to indicate when service is needed.

### 2. Description of Related Art:

Service indicators, such as LEDs, are typically used to help service technicians locate the correct component to be repaired on a computer system. On many small and mid-range computers, each field replaceable unit (FRU) has an unlabeled LED which represents the FRU that needs to be repaired. The LED is physically mounted on the FRU itself or the second level package that includes the FRU. Therefore, the LED does not need to be labeled since it

is physically located on the FRU, or the FRU's outer package, that needs service. In these systems, there is a one-to-one correspondence between each FRU and the indicator that represents the FRU. Thus, in these systems, each FRU is associated with and represented by its own LED.

On high end systems, because of the density of the package and number of FRUs involved, a light strip is sometimes used to mount the LEDs in a visible location. Thus, instead of being mounted directly on the FRU or the second level package that includes the FRU, each LED is mounted on the light strip. The light strip includes an LED for each FRU in the system. In this example, there remains a one-to-one correspondence between FRUs and LEDs. Each individual FRU is associated with and represented by its own LED.

In some high end systems, all of these LEDs could total in the hundreds. This creates many problems. The light strip must be very large and located somewhere close to the central processing complex that includes the processing nodes, but not in the way of service technicians or airflow for cooling. There may be problems with lighting this large number of LEDs in standby mode of operation. And, it may be hard for the service technician to distinguish which LED is associated with which FRU because of the large number of LEDs. This then defeats the purpose of having LEDs.

In addition to the LED that indicates whether a particular FRU needs service, other indicators may be used to indicate whether a particular FRU is currently receiving power. Thus, each individual FRU will have one or more indicators that represent its status. When the

power status of an FRU is to be indicated, the FRU will have two indicators associated with it, one to indicate service and one to indicate power status.

Some FRUs support concurrent replacement. Concurrent replacement means that an FRU may be replaced while the system is running. It is imperative that a service technician know the status of the power on the FRU before attempting to replace it. If the power is not in the correct state and the service technician attempts to replace the FRU, it could cause the system to checkstop and crash for what would otherwise have been a concurrent repair.

Therefore, a need exists for a method, system, and product indicating power status for field replaceable units (FRUs) where hierarchically encoded service indicators are used to indicate when service is needed.

## SUMMARY OF THE INVENTION

A method, system, and product are disclosed for indicating a power status of multiple devices using hierarchically encoded indicators. Multiple nodes are included within a data processing system. Each node includes a different implementation of the devices. Each one of a first level of power indicators are associated with a different one of the nodes. Each one of a second level of power indicators are associated with a different one of the devices. A power status of each node is indicated utilizing one of the first level of power indicators. A power status of each device is indicated utilizing the second level of power indicators.

The above as well as additional objectives, features, and advantages of the present invention will become apparent in the following detailed written description.

## BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

**Figure 1** is a block diagram of a data processing system in which the present invention may be implemented in accordance with the present invention;

**Figure 2** is a block diagram of an exemplary logically partitioned platform in which the present invention may be implemented in accordance with the present invention;

**Figure 3** depicts a block diagram of a computer system including a node enclosure and I/O drawers in accordance with the present invention;

**Figure 4** illustrates a more detailed block diagram of a node enclosure in accordance with the present invention;

**Figure 5** depicts a more detailed block diagram of a node in accordance with the present invention;

**Figure 6** illustrates a block diagram of a front panel indicator panel for indicating when FRUs need to be serviced in accordance with the present invention;

**Figure 7** illustrates a block diagram of a back panel indicator panel for indicating when FRUs need to be serviced in accordance with the present invention;

**Figure 8** depicts a high level flow chart that illustrates monitoring the current power status for each node, and for each FRU that supports replacement during system operation in accordance with the present invention;

**Figure 9** illustrates a high level flow chart that depicts setting a power indicator for a node in accordance with the present invention;

**Figure 10** depicts a high level flow chart that illustrates setting a power indicator for a particular type of FRU that supports replacement during system operation in accordance with the present invention; and

**Figure 11** illustrates a high level flow chart that depicts commanding the power indicators to indicate current power status for a specified node in accordance with the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention and its advantages are better understood by referring to the figures, like numerals being used for like and corresponding parts of the accompanying figures.

The present invention is a method, system, and product using hierarchically encoding indicators to indicate the present power status of devices. A plurality of nodes is provided. Each node includes an implementation of a set of devices. These devices are preferably field replaceable units (FRUs). Thus, multiple different sets of the same FRUs exist, one in each node. The present invention provides first level indicators that are associated with the nodes. Second level indicators are also provided that are associated with the FRUs in the nodes.

Each first level indicator is associated with a different node. Each second level indicator is associated with and represents a particular FRU included in the set for all nodes. Thus, a single second level indicator is associated with and represents multiple FRUs. Each second level indicator represents one of the FRUs of the set for each node. Therefore, if there are four nodes, each having a set of the same FRUs, the second level indicators will each represent four FRUs, one FRU of the set in each node.

The indicators are preferably implemented using LEDs, although any suitable type of indicator may be used. At the node level, each first level indicator indicates the power status of the FRUs included in that node. If none of the FRUs are receiving power, the LED

associated with and representing this node will be deactivated by turning the LED off. If at least one of the FRUs in the node is receiving power, the LED that is associated with this node will be activated by turning the LED on.

At the device, or FRU, level, the second level indicators will each indicate the power status for the associated FRUs in all nodes. For example, if a particular FRU in the set of FRUs is receiving power in each one of the nodes, i.e. the four FRUs are all presently receiving power, the second level indicator that is associated with this particular FRU will be activated. If none of the FRUs in any of the nodes is receiving power, the second level indicator will be deactivated. And, if at least one but not all of the FRUs is receiving power, the second level indicator will be partially activated, such as by causing the LED to blink.

A first type of indicator is described herein as an identity indicator. A second type of indicator is described herein as a power indicator. The power indicators include a first level indicator for indicating power at a node level and a second level indicator for indicating power at a FRU level. A hierarchical indicator is also described that may be used in conjunction with the identity indicators for identifying particular instances of actual FRUs.

**Figure 1** depicts a block diagram of a data processing system in which the present invention may be implemented in accordance with the present invention. Data processing system **100** may be a symmetric multiprocessor (SMP) system including a plurality of

processors **102**, **103**, **104**, and **105** connected to a bus **106**. For example, data processing system **100** may be an IBM eServer pSeries, a product of International Business Machines Corporation in Armonk, New York. Data processing system **100** includes a central electronic complex (CEC) **101** which may include logically partitioned hardware. CEC **101** includes a plurality of processors **102**, **103**, **104**, and **105** connected to system bus **106**. Alternatively, a single processor system may be employed. Also connected to system bus **106** is memory controller/cache **108**, which provides an interface to a plurality of local memories **160-163**. RIO Hub **110** is connected to system bus **106** and provides an interface to RIO bus **112**. Memory controller/cache **108** and RIO Hub **110** may be integrated as depicted.

Data processing system **100** may be a logically partitioned data processing system. Thus, data processing system **100** may have multiple heterogeneous operating systems (or multiple instances of a single operating system) running simultaneously. Each of these multiple operating systems may have any number of software programs executing within it. Data processing system **100** may be logically partitioned such that different PCI slots, to which PCI I/O adapters may be coupled may each be assigned to different logical partitions. In this case, graphics adapter **148** provides a connection for a display device (not shown), while hard disk adapter **149** provides a connection to control hard disk **150**.

Remote Input/Output (RIO) to PCI bridge **114** is connected to RIO bus **112** and provides an interface to PCI

bus **117** and PCI bus **118**. RIO to PCI bridge **114** includes one or more PCI host bridges (PHB), such as PHB **115** and PHB **116**. Each PHB is coupled to a PCI to PCI bridge through a PCI bus. For example, PHB **115** is coupled to PCI to PCI bridge **119** through PCI bus **117**. PHB **116** is coupled to PCI to PCI bridge **126** through PCI bus **118**.

An I/O device may be coupled to data processing system **100** utilizing an I/O adapter. For example, as depicted, I/O device **123** is coupled to I/O adapter **125**.

A memory mapped graphics adapter **148** may be connected to RIO bus **112** through PCI bus **144**, EADS **142**, PCI bus **141**, and RIO to PCI bridge **140**. A hard disk **150** may be coupled to hard disk adapter **149** which is connected to PCI bus **145**. In turn, this bus is connected to EADS **142**, which is connected to RIO to PCI Bridge **140** by PCI bus **141**.

An RIO to PCI bridge **132** provides an interface for a PCI bus **133** to connect to RIO bus **112**. PCI I/O adapter **136** is connected to EADS **134** by PCI bus **135**. EADS **132** is connected to PCI bus **133**. This PCI bus also connects RIO to PCI bridge **132** to the service processor mailbox interface and ISA bus access pass-through logic **194** and PCI-to-PCI bridge **132**. Service processor mailbox interface and ISA bus access pass-through logic **194** forwards PCI accesses destined to the PCI/ISA bridge **193**. NVRAM storage **192** is connected to the ISA bus **196**. Service processor **135** is coupled to service processor mailbox interface and ISA bus access pass-through logic **194** through its local PCI bus **195**. Service processor **135** is also connected to processors **102-105** via a plurality

of JTAG/$I^2C$ busses **134**. JTAG/$I^2C$ busses **134** are a combination of JTAG/scan busses (see IEEE 1149.1) and Phillips $I^2C$ busses. However, alternatively, JTAG/$I^2C$ busses **134** may be replaced by only Phillips $I^2C$ busses or only JTAG/scan busses. All SP-ATTN signals of the host processors **102**, **103**, **104**, and **105** are connected together to an interrupt input signal of the service processor. The service processor **135** has its own local memory **191**, and has access to the hardware OP-panel **190**.

Data processing system **100** may be implemented using various commercially available computer systems. For example, data processing system **100** may be implemented using IBM eServer pSeries system available from International Business Machines Corporation. Such a system may support logical partitioning using an AIX, which is also available from International Business Machines Corporation.

Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 1** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

With reference now to **Figure 2**, a block diagram of an exemplary logically partitioned platform is depicted in which the present invention may be implemented. The hardware in logically partitioned platform **200** may be implemented as, for example, data processing system **100** in **Figure 1**. Logically partitioned platform **200** includes partitioned hardware **230**, operating systems **202**, **204**,

**206, 208,** and hypervisor **210**. Operating systems **202, 204, 206,** and **208** may be multiple copies of a single operating system or multiple heterogeneous operating systems simultaneously run on platform **200**. These operating systems may be implemented using AIX which are designed to interface with a hypervisor. Operating systems **202, 204, 206,** and **208** are located in partitions **203, 205, 207,** and **209**. Additionally, these partitions also include firmware loaders and partition support **211, 213, 215,** and **217**. When partitions **203, 205, 207,** and **209** are instantiated, a copy of the open firmware is loaded into each partition by the hypervisor's partition manager. The processors associated or assigned to the partitions are then dispatched to the partitions' memory to execute the partition firmware.

Partitioned hardware **230** includes a plurality of processors **232-238**, a plurality of system memory units **240-246**, a plurality of input/output (I/O) adapters **248-262**, and a storage unit **270**. Partitioned hardware **230** also includes service processor **290**, which may be used to provide various services, such as processing of errors in the partitions. Each of the processors **232-238**, memory units **240-246**, NVRAM storage **298**, and I/O adapters **248-262** may be assigned to one of multiple partitions within logically partitioned platform **200**, each of which corresponds to one of operating systems **202, 204, 206,** and **208**.

Partition management firmware (hypervisor) **210** performs a number of functions and services for partitions **203, 205, 207,** and **209** to create and enforce the partitioning of logically partitioned platform **200**.

Hypervisor **210** is a firmware implemented virtual machine identical to the underlying hardware. Hypervisor software is available from International Business Machines Corporation. Firmware is "software" stored in a memory chip that holds its content without electrical power, such as, for example, read-only memory (ROM), programmable ROM (PROM), erasable programmable ROM (EPROM), electrically erasable programmable ROM (EEPROM), and non-volatile random access memory (non-volatile RAM). Thus, hypervisor **210** allows the simultaneous execution of independent OS images **202, 204, 206,** and **208** by virtualizing all the hardware resources of logically partitioned platform **200**.

**Figure 3** depicts a block diagram of a computer system **300** including a node enclosure **302** and I/O drawers **304-310** in accordance with the present invention. Computer system **300** may communicate with other systems via one or more of the I/O drawers **304-310**.

**Figure 4** illustrates a more detailed block diagram of node enclosure **302** in accordance with the present invention. Node enclosure **302** includes multiple nodes **402-408**, multiple cooling units **410-420**, and multiple power units **422-444**. Cooling units **410-420** and power units **422-444** are used to cool and power nodes **402-408**.

**Figure 5** depicts a more detailed block diagram of a node **500** in accordance with the present invention. Node **500** may be used to implement any of nodes **402-408**. Node **500** includes a planar card Px on which are connected processors C26 and C27, memory DIMMs C14-C25, various I/O cards and adapters C5-C13, and redundant clocks and service processors C1-C4. Each Px and C1-C27 device in

each node is an individual field replaceable unit (FRU). Therefore, each one of the Px and C1-C27 FRUs needs to be associated with an identity indicator that indicates when the actual FRU needs to be serviced, such as by being replaced or repaired.

The set of Px and C1-C27 FRUs is replicated throughout nodes **402-408**. There is a separate set of Px and C1-C27 FRUs in each node **402-408**.

**Figure 6** illustrates a block diagram of a front panel indicator panel **600** for indicating when FRUs need to be serviced in accordance with the present invention. **Figure 7** illustrates a block diagram of a back panel indicator panel **700** for indicating when FRUs need to be serviced in accordance with the present invention. The identity indicators included in panels **600** and **700** are labeled according to the FRU they are associated with in order to assist a service technician in quickly identifying and locating an actual FRU that requires service.

Indicator panels **600** and **700** include an identity indicator, such as an amber LED, associated with the FRUs in a node enclosure. Some amber identity indicators represent only one actual FRU, while other amber identity indicators represent several FRUs. There are some FRUs, such as the clock, service processor, and power supplies, where there are multiple instances of the same FRU where each instance of the FRU is associated with its own amber indicator. Thus, there is a one-to-one association between indicators and FRUs for some FRUs, while there is a one-to-many association between other indicators and the FRUs that they represent.

There are several identical sets of Px and C1-C27 FRUs in node enclosure **302**. There is a separate set of Px and C1-C27 FRUs in each node **402-408**. The present invention provides for only one amber identity indicator for each FRU in the set. Thus, there are 28 indicators, one for each of Px and C1-C27. These 28 indicators are used to indicate a Px or C1-C27 FRU no matter what node includes the actual FRU. Therefore, these indicators indicate which FRU in a set requires service but does not indicate the actual FRU that needs service. For these indicators, there is a one-to-many relationship between an indicator and FRUs.

For example, if the amber indicator that is associated with and represents the C5 FRU is activated, a service technician will know that a C5 FRU needs to be replaced. The service technician does not know, just by looking at the single C5 FRU indicator, which actual C5 FRU needs to be replaced. The technician does not know which node includes the C5 FRU that needs to be replaced.

In order to identify an actual FRU that needs to be replaced, the present invention provides for hierarchical indicators in addition to the identity indicators. There is a hierarchical indicator for each level of hierarchy provided. In the present invention, there are two hierarchy levels. There is a set level having the 28 identity indicators, and a node level have four indicators. By looking to the combination of identity and hierarchy indicators, a technician may locate the actual FRU that needs service.

For example, the 28 identity indicators are provided as Px and C1-C27. In addition, hierarchy indicators **602**, **604**, **606**, and **608** are provided. The hierarchy indicators

**602**, **604**, **606**, and **608** are used in conjunction with the 28 identity indicators in order to identify an actual FRU. One of the identity indicators will be activated to identify one of the FRUs of the set. And, in order to identify the actual FRU that needs service, one of the hierarchy indicators **602**, **604**, **606**, and **608** will be activated simultaneously. For example, if the C6 FRU in P4 node **406** needs service, amber identity indicator **612** and amber identity indicator **606** will both be activated simultaneously.

Some identity indicators represent just one actual FRU. For example, amber indicators A1-A6 (see **Figures 6** and **7**) are associated with and indicate whether cooling units **410-420** need service. Amber indicator A1 is associated with cooling unit **410**. Amber indicator A2 is associated with cooling unit **412**. Amber indicator A3 is associated with cooling unit **414**. Amber indicator A4 is associated with cooling unit **416**. Amber indicator A5 is associated with cooling unit **418**. And, amber indicator A6 is associated with cooling unit **420**.

As another example, there are twelve separate power units **422-444** depicted in node enclosure **302**. There is a one-to-one correspondence between E1-E12 indicators and power units **422-444**. Amber indicator E1 is associated with and indicates whether power unit **422** needs service. Amber indicator E2 is associated with and indicates whether power unit **424** needs service. Amber indicator E3 is associated with and indicates whether power unit **426** needs service. Amber indicator E4 is associated with and indicates whether power unit **428** needs service. Amber indicator E5 is associated with and indicates whether

power unit **430** needs service. Amber indicator E6 is associated with and indicates whether power unit **432** needs service. Amber indicator E7 is associated with and indicates whether power unit **434** needs service. Amber indicator E8 is associated with and indicates whether power unit **436** needs service. Amber indicator E9 is associated with and indicates whether power unit **438** needs service. Amber indicator E10 is associated with and indicates whether power unit **440** needs service. Amber indicator E11 is associated with and indicates whether power unit **442** needs service. And, amber indicator E12 is associated with and indicates whether power unit **444** needs service.

Some identity indicators represent multiple FRUs. Some sets of FRUs are found in more than one node in node enclosure **302**. Thus, a set of FRUs may be replicated in node enclosure **302** such that several nodes include one of these sets of FRUs. As described above, the present invention provides a set of amber indicators where each amber indicator in the set represents an FRU included in the set of FRUs. Each one of these amber indicators then represents a particular FRU but does not by itself indicate an actual FRU in a particular node. These amber indicators do not indicate by themselves which set includes an FRU represented by the indicator. Thus, when one of the amber indicators is activated, it indicates that an FRU needs service, but does not indicate which set of FRUs includes the FRU that needs service. In addition to the set of amber indicators, there are hierarchical indicators that indicate which set includes an actual FRU that needs service. Thus, for sets of FRUs that are replicated throughout the node enclosure, there

is a one-to-many relationship between amber indicators and actual FRUs.

For example, each node includes a set of FRUs C1-C27. Instead of providing 112 different indicators which would be required for a system having 28 indicators repeated in four different nodes, the present invention provides for only 32 indicators. Thus the indicators in box **601** indicate the status of the FRUs in the set of FRUs found in each node. When one of these indicators is activated, it means that a FRU needs service in one of the nodes. In order to determine which node includes the actual FRU that needs service, a hierarchical amber indicator is included for each node. Thus, amber indicator P2 **602** is associated with node **402**. Amber indicator P3 **604** is associated with node **404**. Amber indicator P4 **606** is associated with node **406**. And, amber indicator P5 **608** is associated with node **408**.

An amber indicator is provided for set of FRUs C1-C27 and for the planar itself Px. For example, amber indicator C1 **610** is provided and indicates whether the FRU C1 needs service on one of the nodes P2-P5 **402-408**. Amber indicator C6 **612** is provided and indicates whether the FRU C6 needs service on one of the nodes P2-P5 **402-408**. And, amber indicator C11 **622** is provided and indicates whether the FRU C11 needs service on one of the nodes P2-P5 **402-408**. Amber indicator Px **616** is provided and indicates whether one of the planars needs service.

When an FRU on one of the nodes needs service, the amber indicator that is associated with that FRU is activated. For example, if FRU C6 on node P4 **406** needs service, amber indicator **612** is activated. According to

the present invention, indicators **602-608** for nodes **402-408** are used to indicate which node **402-408** includes the particular FRU that needs service. In this example, amber indicator P4 **606** will be activated. In this manner, indicator **612** indicates that a C6 FRU needs to be serviced, and indicator **606** is used to indicate that the actual C6 FRU that needs service is located on node **406**.

The present invention also provides for a set of green power indicators that indicate whether an FRU is currently receiving power. Some of the FRUs may be replaced while the system is running. However, it is still important to know whether the FRU is currently receiving power prior to attempting to replace the FRU. For the FRUs that are of a type which permit replacement while the system is running, a green power indicator is also provided.

For example, the C1, C3, C5, C6, C8, C9, C11, and C13 FRUs are types of FRUs that can be replaced while the system is running. For example, green power indicator **618** indicates whether any of the C1 FRUs are currently receiving power in any of the nodes **402-408**. Green power indicator **620** indicates whether any of the C6 FRUs are currently receiving power in any of the nodes **402-408**. And, green power indicator **626** indicates whether any of the C11 FRUs are currently receiving power in any of the nodes **402-408**.

The present invention provides for use of the green power indicators in two ways. The green power indicators of panels **600** and **700** may be lit to indicate whether any of the nodes **402-408** and FRUs are receiving power. Thus, a green power indicator of box **601** will be activated if

the FRUs represented by that green power indicator in each node are currently receiving power. If none of the FRUs represented by that green power indicator are receiving power in any of the nodes, its green power indicator will be off. If at least one FRU but not all of the FRUs represented by the green power indicator are receiving power, the green power indicator will blink.

Green power indicators **624-630** are used to indicate whether power is present on any of the FRUs included in the node associated with the indicator. Power indicator **624** will be activated if there is a voltage present on any of the FRUs included in node P2 **402**. Power indicator **626** will be activated if there is a voltage present on any of the FRUs included in node P3 **404**. Power indicator **628** will be activated if there is a voltage present on any of the FRUs included in node P4 **406**. And, power indicator **630** will be activated if there is a voltage present on any of the FRUs included in node P5 **408**.

A second method for using the green power indicators is to select just one node to evaluate. Thus, in this case, the panels **600** and **700** are set by a command to indicate only one node as described below.

For example, a service technician may wish to see the power status for the FRUs of node P3 **404** which may be replaced while the system is running. A command will be sent from a microcontroller that is executing the present invention to panels **600** and **700** causing the panels' green power indicators to indicate power status for node P3 **404**. In this case, a green power indicator of box **601** will be on if the FRU in node P3 that is represented by

the green power indicator is receiving power and off if it is not.

**Figure 8** depicts a high level flow chart that illustrates monitoring the current power status for each node, and for each FRU that supports replacement during system operation in accordance with the present invention. The process starts as depicted by block **800** and thereafter passes to block **802** which illustrates monitoring the power status for each node, and for each FRU that supports replacement during system operation for each node, using the I2C bus. Next, block **804** depicts activating the power status indicators, such as by illuminating the green LEDs, according to the processes depicted by **Figures 9-11**.

**Figure 9** illustrates a high level flow chart that depicts setting a power indicator for a node in accordance with the present invention. The process starts as illustrated by block **900** and thereafter passes to block **902** which depicts a determination of whether or not the power is off for all FRUs for this particular node. If a determination is made that the power is not off for all FRUs for this node, the process passes to block **904** which illustrates activating the power status indicator, such as by illuminating the green LED, that is associated with this node. The process then passes back to block **902**.

Referring again to block **902**, if a determination is made that the power is off for all FRUs for this node, the process passes to block **906** which depicts deactivating the power status indicator, such as by

turning the green LED off, that is associated with this node. The process then passes back to block **902**.

**Figure 10** depicts a high level flow chart that illustrates setting a power indicator for a particular FRU that supports replacement during system operation in accordance with the present invention. The process depicted by **Figure 10** is repeated for each FRU position in the node that supports replacement during system operation.

The process starts as depicted by block **1000** and thereafter passes to block **1002** which illustrates a determination of whether or not the power is off for all FRUs represented by a particular power status indicator in all nodes. If a determination is made that power is off for all FRUs represented by a particular power status indicator in all nodes, the process passes to block **1004** which depicts deactivating the power status indicator, such as by turning the green LED off. The process then passes back to block **1002**.

Referring again to block **1002**, if a determination is made that power is not off for all FRUs represented by the particular power status indicator in all nodes, the process passes to block **1006** which depicts a determination of whether or not power is on for all FRUs represented by the particular power status indicator in all nodes. If a determination is made that power is on for all FRUs represented by the particular power status indicator in all nodes, the process passes to block **1008** which illustrates activating the power status indicator, such as by turning the green LED on. The process then passes back to block **1002**.

Referring again to block **1006**, if a determination is made that power is not on for all FRUs represented by the particular power status indicator in all nodes, the process passes to block **1010** which illustrates causing the power status indicator, such as the green LED, to blink. The process then passes back to block **1002**.

**Figure 11** illustrates a high level flow chart that depicts commanding the power indicators to indicate current power status for a specified node in accordance with the present invention. The process starts as illustrated by block **1100** and thereafter passes to block **1102** which depicts specifying a particular node. Next, block **1104** illustrates determining the power status of the selected node and for all FRUs in that node that support replacement during system operation. Thereafter, block **1106** depicts turning the power status indicators, i.e. the green power indicators, for each FRU in the node that supports replacement during system operation either on or off according to its particular current power status. Next, the process passes to block **1108** which depicts a determination of whether or not the power is off for all FRUs for this particular node. If a determination is made that the power is not off for all FRUs for this node, the process passes to block **1110** which illustrates activating the second type of indicator, such as by illuminating the green LED, that is associated with this node. The process then passes back to block **1102**.

Referring again to block **1108**, if a determination is made that the power is off for all FRUs for this node, the process passes to block **1112** which depicts

deactivating the second type of indicator, such as by turning the green LED off, that is associated with this node. The process then passes back to block **1102**.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system. Those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media, such as a floppy disk, a hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and transmission-type media, such as digital and analog communications links, wired or wireless communications links using transmission forms, such as, for example, radio frequency and light wave transmissions. The computer readable media may take the form of coded formats that are decoded for actual use in a particular data processing system.

The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for

various embodiments with various modifications as are suited to the particular use contemplated.